# PATENT SPECIFICATION (11) 1 255 642

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DRAWINGS ATTACHED

(21) Application No. 3478/68 (22) Filed 23 Jan. 1968

(23) Complete Specification filed 6 Jan. 1969

(45) Complete Specification published 1 Dec. 1971

(51) International Classification F 02 f 9/00; B 04 c 3/06, 5/103, 5/14; B 01 d 46/24

(52) Index at acceptance
F1B 5Q3G
B1T 397 496 502 50X 534 538 54X 551 575 598 606 68Y 69X 712
B2P 10B2A3 10B2E 6B 6X 8B



(72) Inventor ALAN WYCLIFFE SPARROW


## (54) IMPROVEMENTS IN OR RELATING TO CRANKCASE BREATHERS FOR INTERNAL COMBUSTION ENGINES


(71) We, PERKINS ENGINES LIMITED, a British Company, of 35 Davies Street, London, W.1., Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


This invention relates to crankcase breathers for internal combustion engines.

During operation of an internal combustion engine some of the gases from the combustion chambers generally leak into the engine crankcase. As these gases, commonly known as 'blow-by-gases', contain water vapour, unburnt fuel and other products of combustion it is desirable to remove them from the crankcase through a breather. The breather also allows air to pass into and out of the crankcase to compensate for changes in crankcase volume.

However, it has been found that the blow-by-gases, as they escape through the breather, carry lubrication oil with them. This oil loss is disadvantageous in that it is uneconomical, fouls the external parts of the engine, and pollutes the atmosphere.

Internal combustion engines are known which have a closed breathing system in which the blow-by-gases are fed into the inlet manifold of the engine and are re-used. The disadvantage of this system is that lubrication oil is carried by the blow-by-gases into the combustion chamber. This oil in the combustion chamber causes the engine to 'run-on' after the fuel supply or ignition has been cut-off.

It is an object of the present invention to obviate or mitigate the above mentioned disadvantages.

According to the present invention there is provided, for a crankcase for an internal combustion engine, a breather including means for separating, fro ma gas from a crankcase, oil suspended in said gas, means for venting said gas, subsequent to such separation, and a duct adapted to contain a pressure head of separated oil so that, in use, the duct allows the separated oil to return to the crankcase while preventing back flow through the duct from the crankcase, and in which said means for separating oil suspended in said gas comprises a primary and a secondary oil separator.

Further, according to the present invention there is provided in an internal combustion engine, a crankcase breather including primary and secondary means for separating from the blow-by-gases from the crankcase, oil suspended in said gases, means for venting said blow-by-gases subsequent to such separation, and a duct extending from the breather into the crankcase for returning the separated oil thereto, said duct being adapted to contain a pressure head so that, in use, the duct allows the separated oil to return to the crankcase while preventing back flow from the crankcase.

The means for separating the oil may be a mesh filter, such as a wire mesh filter, or a centrifugal filter, and the duct may be formed as a U-tube.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 shows a sectional front view of a first embodiment of a breather according to the invention situated on a rocker box for an internal combustion engine;

Fig. 2 shows a sectional front view of a second embodiment of a breather according to the invention situated on a rocker box for an internal combustion engine;

Fig. 2A shows a detail of Fig. 2;

Fig. 3 shows a sectional plan view on the line III—III of Fig. 2;

Fig. 4 shows a sectional front view of a third embodiment of a breather according to the invention situated on a rocker box for an internal combustion engine;

Fig. 5 shows a plan view corresponding to Fig. 4;

Fig. 6 shows a sectional front view of a

modified form of the breather shown in Figs. 4 and 5;

Fig. 7 shows a sectional front view of a further modified form of the breather shown in Figs. 4 and 5;

Referring to Fig. 1 there is shown a crankcase breather indicated generally at 1 and mounted on the rocker box 2 of an internal combustion engine. An inlet 3 to the breather opens out from the rocker box 2 and an upright tube 4 extends from the inlet into a cylindrical outer casing 5. The casing 5 surrounds the tube 4 and has a downwardly convergent portion 6 connected to said tube 4 at or near the inlet 3. A cap 7 fits over the upper end of the tube 4 and has an overhanging portion 8 which partially closes the open end of the annular chamber 9 formed between the tube 4 and the casing 5. The overhanging portion 8 contains a first wire mesh filter 10 and is provided with outlet apertures 11 to permit the flow of gases from the tube 4 through the filter 10 into the annular chamber 9. A second wire mesh filter 12 is provided around the inner periphery of the casing 5 and extends inwardly to the overhanging portion 8 of the cap 7 so that gases being vented to the atmosphere from the chamber 9 must first pass through said filter 12.

A duct 13 connects the interior of the rocker box 2 with the chamber 9 at a point adjacent the connection between the tube 4 and the convergent portion 6 of the casing 5, and a portion of the duct 13 within the rocker box 2 is formed as a U-tube 14 as shown.

In operation, blow-by-gases with lubricating oil suspended therein pass from the crankcase of the engine to the rocker box 2 at a pressure $P_1$ which is greater than atmospheric pressure. The pressure difference between the interior of the rocker box 2 and the atmosphere causes the mixture of gases and oil to enter the breather through the inlet 3 and flow up the tube 4 into the cap 7. The mixture of gases and oil now passes into the first wire mesh filter 10 in which a primary separation of the oil from the gases takes place. The separated oil drops from the filter 10 into the chamber 9, falling on to the portion 6 of the outer casing 5 and running to the bottom of the latter. The gases in the chamber 9 still carry some oil in suspension and the mixture has, by passing through the filter 10, had its pressure reduced to $P_2$ which is still greater than atmospheric pressure. The mixture thus passes into the second wire mesh filter 12 and a secondary separation of the oil from the gases takes place. The separated oil again runs to the bottom of the casing 5 and the gases are vented to the atmosphere. The separated oil is returned to the rocker box through the duct 13. However, as the pressure $P_1$ in the rocker box is greater than the pressure $P_2$ in the chamber 9, a pressure lock must be provided in the duct to prevent a back flow of the blow-by-gases into the breather. To this end the portion of the duct 13 formed as a U-tube 14 is filled with lubricating oil 15 either before operation of the engine begins or with separated oil which accumulates during the initial running period of the engine. During operation of the engine there is formed in the limb 16 of the U-tube a pressure head A which equals the difference in pressure ($P_1$—$P_2$). The latter is thus compensated and the blow-by-gases in the rocker box do not enter chamber 9 through the duct 13. As the separated oil runs into the head of oil a corresponding volume of oil is spilled from the limb 17 of the U-tube and is thus returned to the engine.

In a modified form of the embodiment described above the duct 13 is not formed as a U-tube but either extends into a reservoir 18 of lubricating oil, such as the engine sump, as shown in broken lines in Fig. 1, or the duct 13 is twisted to form a vertical loop.

Figures 2, 2A and 3 show a second embodiment of a breather generally indicated at 19 and having a stepped cylindrical outer casing 20. A downwardly-convergent portion 21 of the casing 20 is connected to the upper end of a duct 22 of reduced diameter relative to the casing. The duct 22 extends downwardly and is connected at its lower end to the crankcase 23 of an internal combustion engine. A vertical loop 24 is formed intermediate the ends of the duct 20 so as to form a pressure lock as described above. The upper, stepped portion 26 of the cylindrical casing 20 supports a wire mesh filter 27 which closes the open end thereof and an inlet tube 28 opens tangentially into the lower portion 29 of the casing.

The tube 28 is connected to the rocker box 25 of an internal combustion engine. The open end of the casing 20 has a fitted cover 30 which includes a diaphragm-operated, pressure limiting valve 31 (Fig. 2A) and is connected to the inlet manifold 32 of the engine by a duct 33 thus forming a closed breathing system. The cover 30 is located by a spring clip 34 and the valve 31 operates in accordance with fluctuations in the vacuum in the inlet manifold 32 so as to prevent or allow the entry of blow-by-gas into the manifold.

In operation the loop 24 fills with oil as did the U-tube in the embodiment already described so as to form a pressure lock. A mixture of blow-by-gases and oil suspended therein flows into the breather through the inlet tube 28 and around the lower portion 29 of the casing 20 as shown by the arrows in Fig. 3. Primary separation of the oil from the gases takes place by centrifugal action and the separated oil runs down the convergent portion 21 of the casing into the duct 22.

The mixture of blow-by-gases and oil now passes into the filter 21 where a secondary separation of the oil takes place; the gases venting into the inlet manifold 32 through the

valve 31 and the separated oil running into the duct 22. The blow-by-gases flow through the breather by virtue of the pressure differentials already described with reference to the first embodiment and as in the first embodiment a pressure head A is formed in the loop 24. The separated oil runs down the duct 22 into the pressure head and a corresponding volume overflows out of the loop 24 and is returned to the crankcase 23.

The breather shown in Figs. 4 and 5 is formed as an integral part of a rocker box 35 for a V-engine and has a cylindrical outer casing 36 and a base 37. The base 37 is formed in common with part of one side of the rocker box. An inlet aperture 38 is formed in the base intermediate the outer casing 36 and an annular central flange 39. A closed permeable wall tube 40 forms an upwardly directed extension of the flange 39 and the latter has a downwardly-convergent central bore 41. A correspondingly downwardly-convergent cup 42 is supported in said central bore 41 and has its lower closed end portion 43 extending into the interior of the rocker box 35. A cylindrical duct 44 is supported in the cup 42 by an annular plug 45 and extends into the cup to a point adjacent the closed end thereof. A hole 46 is provided in the wall of the cup above the lower end of said duct and within the rocker box, and the end of the duct 44 remote from the rocker box opens into a chamber 47 formed within the tube 40. A cover 48 extends across the open end of the outer casing 36 to prevent damage to a helical ramp 49 mounted on the flange 39, and to the tube 40. The helical ramp 49 is formed from either metal, plastics material or resin-based paper. The tube 40 may be formed from either fine wire or fine glass mesh.

In operation, the rocker box 35 is fitted to an internal combustion engine and the cup 43 is filled with oil, as described above, to the level of the hole 46. A mixture of blow-by-gases and oil suspended therein passes from the crankcase of the engine into the rocker box 35 and, by virtue of the pressure differential already described, flows through the inlet aperture 38 and up the helical ramp 49. Centrifugal forces acting on the mixture cause primary separation of the oil from the gases; the separated oil running to the centre of the helical ramp 49 and passing through the tube 40, where secondary separation takes place, and the gases being vented to the atmosphere. As the tube 40 restricts the flow of gases therethrough a pressure drop occurs across it; thus a pressure head is formed in the duct 44. The separated oil passes down the tube 40 into the pressure head and a corresponding volume of oil spills from the hole 46 into the engine.

Fig. 6 shows a modified form of the breather shown in Figs. 4 and 5, corresponding parts having the same reference numerals but with the suffix A. The helical ramp 49A is formed integral with the tube 40A and the flights of the ramp are hollow. The ramp 49A and the tube 40A are both made of a permeable material so that the separated oil has a larger area to soak through than in the embodiment shown in Figs. 4 and 5. Otherwise the operation of the breather of Fig. 6 is identical to that of the Figs. 4 and 5 embodiments. The ramp and the tube may be produced by dip moulding in a permeable plastics material.

A further modified form of the embodiment of Figs. 4 and 5 is shown in Fig. 7, again the same reference numerals indicate corresponding parts but with the suffix B. A further mesh separator 55 has been added to the outlet from the breather to facilitate further separation of oil from the gases. The oil thus separated drops down on to the top flight of the helical ramp 49B to join the oil separated by the centrifugal action. Otherwise the operation is identical to that of the embodiment shown in Figs. 4 and 5. Clearly the breather shown in Fig. 6 may also be provided with a further mesh separator if required.

In the embodiments described above in which the blow-by-gases are vented to the atmosphere, the breather may be adapted to form part of a closed system in which the blow-by-gases vented from the breather are passed to the inlet manifold of an engine either via the inlet side of the air cleaner through a relatively large cross-sectional area, low pressure drop pipe, or directly through a pipe having a pressure-limiting valve because of the reduced pressure prevailing in the inlet manifold.

In the embodiments described above in which the breather is formed as part of, or is connected to, the rocker box of an internal combustion engine, it is clear that any other part of the engine to which the blow-by-gases have access may be used as an alternative to the rocker box. Moreover, the pressure head for each breather may be formed by submerging the outlet duct from the breather in a reservoir of oil, for example, the sump of an internal combustion engine.

WHAT WE CLAIM IS:—

1. For a crankcase for an internal combustion engine, a breather including means for separating, from a gas from a crankcase, oil suspended in said gas, means for venting said gas, subsequent to such separation, and a duct adapted to contain a pressure head of separated oil so that, in use, the duct allows the separated oil to return to the crankcase while preventing back flow through the duct from the crankcase, and in which said means for separating oil suspended in said gas comprises a primary and a secondary oil separator.

2. A breather according to claim 1 including a tube extending from the inlet for said gas upwardly into a cylindrical outer casing having a downwardly-convergent end portion connec-

ted to said tube, a cap on the upper end of said tube and overhanging the latter and permitting passage of the gas into outlet apertures on the overhanging portion of the cap, a first filter in said cap and a second filter around the inner periphery of the casing and extending inwardly to said cap, said duct being connected to the convergent end portion of the casing at or adjacent its connection with said tube so that, in use, gases from a crankcase of an internal combustion engine pass into said tube, through said first filter and through said second filter, and oil separated from the gases in said filters is returned to the crankcase through said duct.

3. A breather according to claim 2, in which said first and second filters are formed from wire mesh.

4. A breather according to claim 1 including a cylindrical outer casing having a downwardly-convergent end portion, an inlet tube for said gases opening into said casing, and a filter extending across the open end of said casing, said duct being connected to said convergent end portion and said inlet tube opening tangentially into said casing so that, in use, gases from an internal combustion engine pass into said inlet tube around said casing and through said filter, and oil separated from the gases by centrifugal forces and by said filter is returned to the crankcase through said duct.

5. A breather according to claim 4, in which said inlet tube is adapted for connection to the rocker box of an internal combustion engine.

6. A breather according to claim 4 or 5, in which said casing includes a stepped portion for supporting the filter.

7. A breather according to any one of claims 4, 5 or 6, in which said filter is formed from wire mesh.

8. A breather according to claim 1 including a cylindrical outer casing having a base, an inlet aperture for said gases in said base and an annular flange on said base, in which a closed permeable-walled tube forms an upwardly directed extension of the flange and said duct opens into a chamber formed within the tube, and in which a helical ramp is mounted on said flange and extends upwardly between said tube and the casing so that, in use, gases from the crankcase of an internal combustion engine flow through the inlet aperture, up said helical ramp and are vented from the open end of the casing, and oil separated from the gases by centrifugal forces runs to the centre of the helical ramp and through the permeable wall of the tube and is returned to the crankcase through said duct.

9. A breather according to claim 8, in which said base is formed in common with one side of a rocker box for an internal combustion engine.

10. A breather according to claim 8 or 9, in which said helical ramp is formed from metal, plastics material or resin-based paper.

11. A breather according to any one of claims 8, 9 or 10, in which said permeable-walled tube is formed from wire or glass mesh.

12. A breather according to claim 8 or 9, in which the helical ramp is moulded integral with the tube, from a permeable material.

13. A breather according to any one of claims 8 to 12 including a filter within said casing and located above said helical ramp so that, in use, said gases having passed up said ramp pass through the filter where further oil separation occurs.

14. A breather according to claim 13 in which said filter is formed from wire mesh.

15. A breather according to any one of the preceding claims, in which the upper or outlet end of the outer casing is adapted for connection to the inlet manifold of an internal combustion engine so as to form part of a closed breathing system therefor.

16. A breather according to claim 15, in which the upper end of the casing had a detachable cover including a diaphragm-operated, pressure limiting valve for controlling the flow of gases from the breather to the inlet manifold of an internal combustion engine.

17. A breather according to any one of the preceding claims, in which said duct includes a vertical loop for containing said pressure head of separated oil.

18. A breather according to any one of claims 1 to 16, in which said duct includes a U-bend for containing said pressure head of separated oil.

19. A breather according to any one of claims 1 to 16, in which said duct extends into a reservoir of oil so as to form said pressure head.

20. A breather according to claim 19, in which said reservoir is contained in a cupped tube having an outlet aperture in the wall thereof for maintaining the reservoir at a predetermined level.

21. In an internal combustion engine, a crankcase breather including primary and secondary means for separating from the blow-by-gases from the crankcase, oil suspended in said gases, means for venting said blow-by-gases subsequent to such separation, and a duct extending from the breather into the crankcase for returning the separated oil thereto, said duct being adapted to contain a pressure head so that, in use, the duct allows the separated oil to return to the crankcase while preventing back flow from the crankcase.

22. A breather for a crankcase of an internal combustion engine substantially as hereinbefore described with reference to Fig. 1 of the accompanying drawings.

23. A breather for a crankcase of an internal combustion engine substantially as hereinbefore described with reference to Figs. 2, 2A and 3 of the accompanying drawings.

24. A breather for a crankcase of an inter-

nal combustion engine substantially as hereinbefore described with reference to Figs. 4 and 5 of the accompanying drawings.

25. A breather for a crankcase of an internal combustion engine substantially as hereinbefore described with reference to Figs. 6 or 7 of the accompanying drawings.

26. In an internal combustion engine, a breather as claimed in any one of claims 1 to 20 or 22 to 25.

H. D. FITZPATRICK & CO.,
Chartered Patent Agents,
14/18 Cadogan Street, Glasgow, C.2.
and
27 Chancery Lane, London, W.C.2.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1971.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1255642 COMPLETE SPECIFICATION

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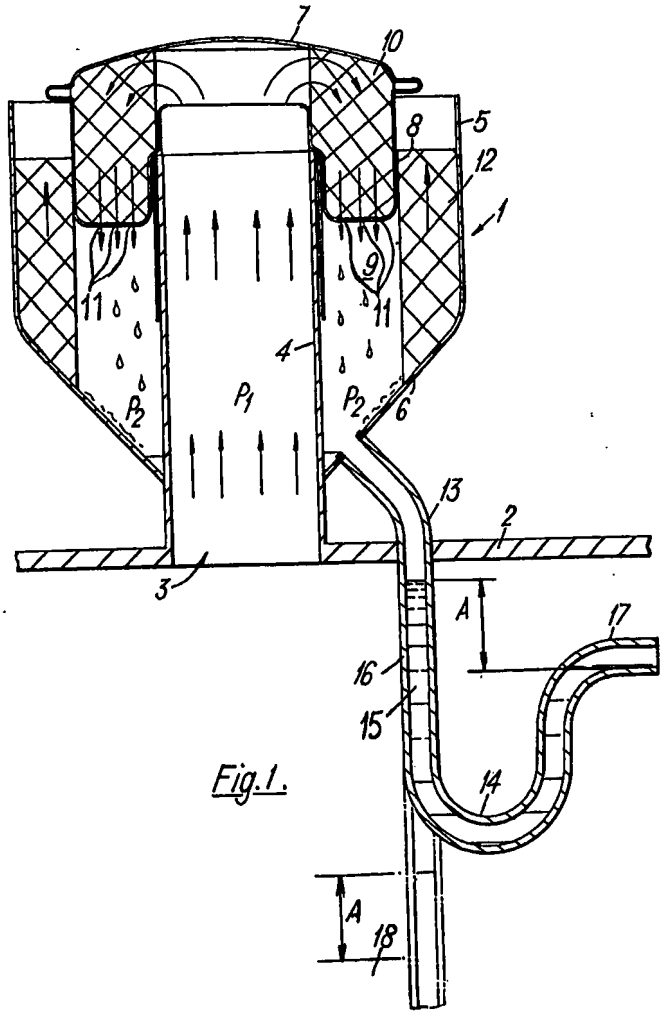


Fig.1.

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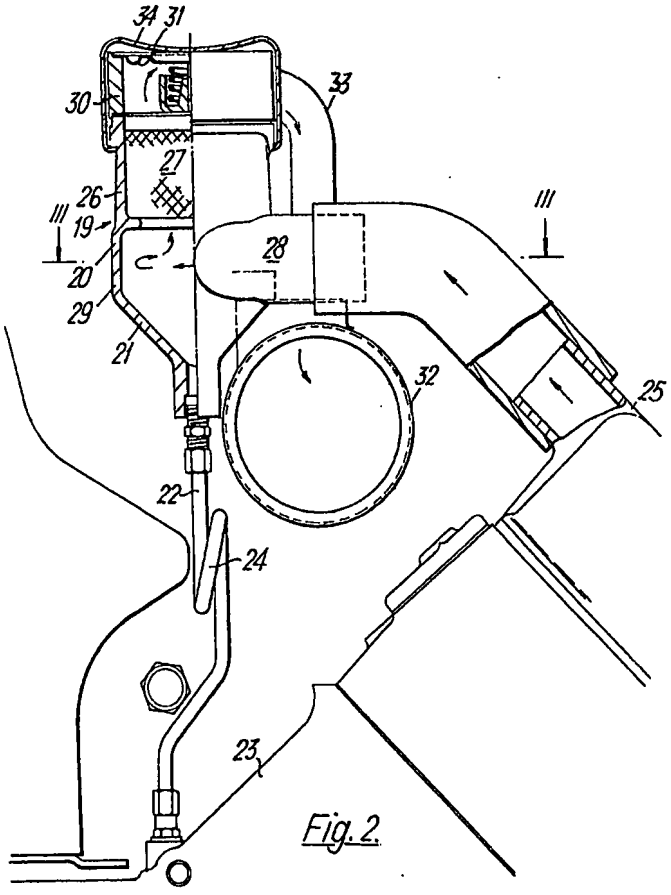


Fig. 2.

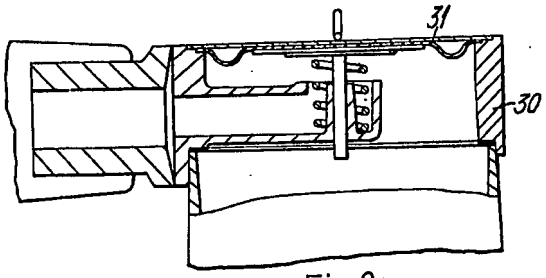


Fig. 2A.

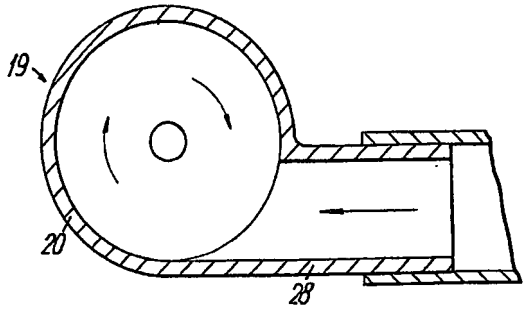


Fig. 3.

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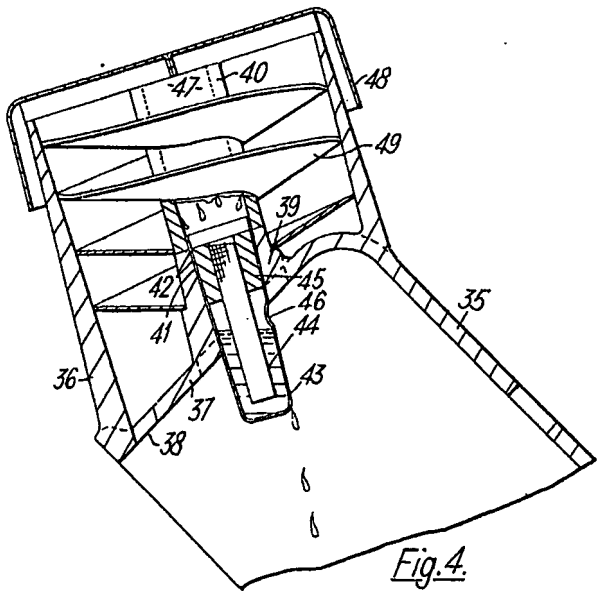


Fig.4.

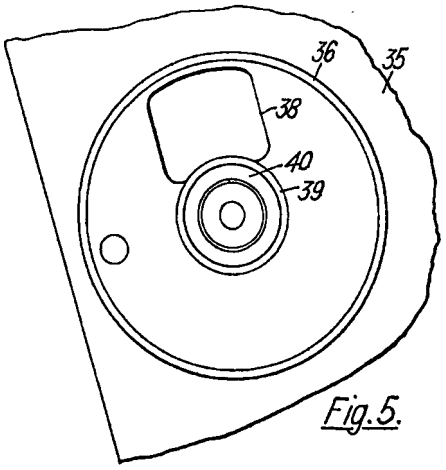


Fig.5.

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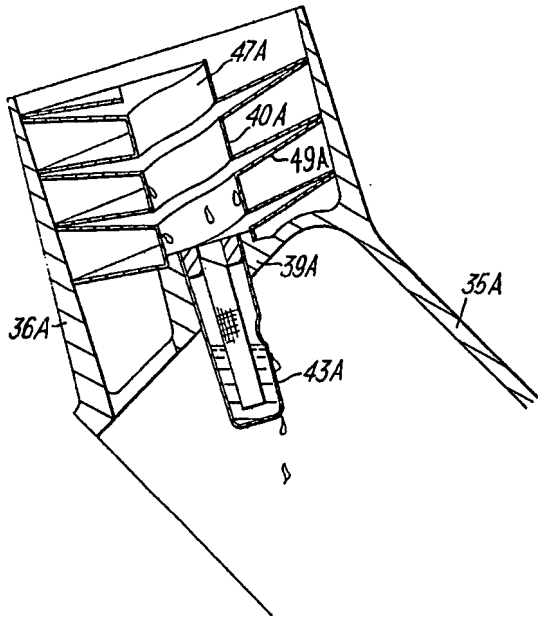


Fig. 6.

1255642 COMPLETE SPECIFICATION

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Sheet 6

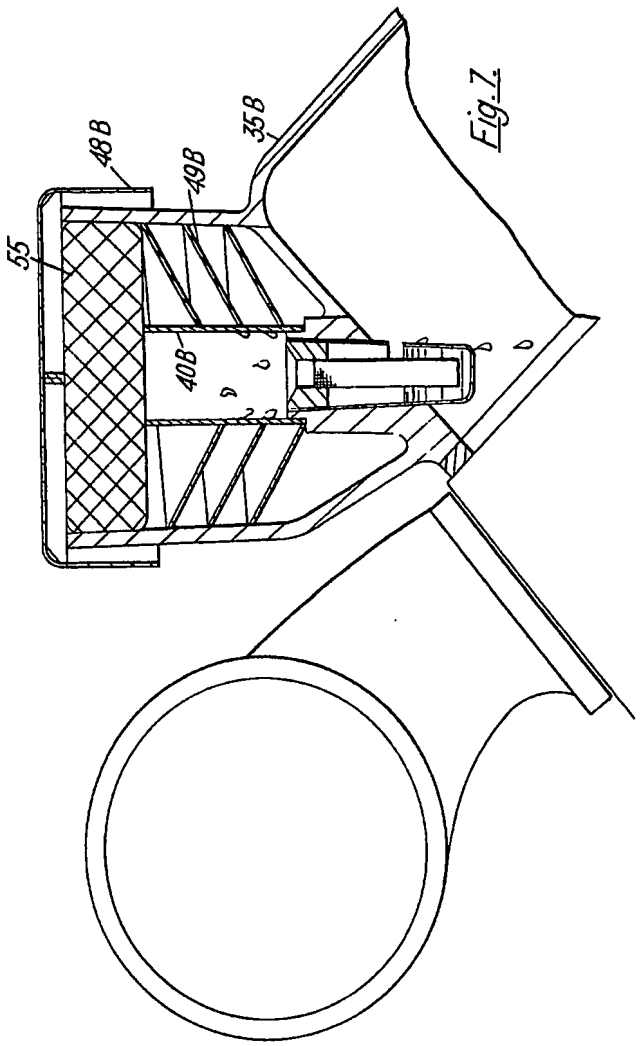


Fig.7.